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Report on the Examination

Biology
Specification B

- Unit BYB1 Core Principles
- Unit BYB2 Genes and Genetic Engineering

Advanced Subsidiary - Subject Code (5416)

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Publications Department, Stag Hill House, Guildford, Surrey, GU2 7XJ
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Kathleen Tattersall, Director General

CONTENTS

Biology

Specification B

Unit BYB1 Core Principles

General Comments

The examiners were pleased to note that many candidates were able to display a good knowledge and understanding of the content of this module. These candidates appeared to be well-prepared and to have been able to take advantage of the more limited range of content in this module compared with the first module in the previous syllabus. A significant proportion gained over 60% of the available marks. On the other hand, there was a considerable number of candidates who had grasped very little of the required material and whose performance was below what might have been expected of a sound GCSE candidate. For some this may well have been due to lack of time for revision and limited experience of examination technique. Others seemed to be completely unfamiliar with certain sections of the content of the specification.

The paper included questions which could be answered by the great majority of candidates, as well as sections of questions that were intended to test the ability of potential grade A AS candidates to apply principles in novel situations, as required by the assessment objectives. It was pleasing to find that all sections of all questions were correctly answered by at least a reasonable proportion of candidates, although, not surprisingly, those requiring data interpretation skills proved most difficult. There was little evidence of candidates being unable to complete the paper, as the great majority had attempted all questions.

Question One

(a) (i) A large majority of candidates gained full marks for calculating the Rf value. The most common error was to measure either from the bottom of the paper or to the top. A few got the equation the wrong way round.

(ii) Most candidates suggested the use of two-way chromatography, but many did not appreciate that they would need to use a different solvent in order to separate the pigments.

(b) Most candidates were aware of the test required, but answers were on the whole disappointing because the specific stages were either confused or lacked the required level of detail. Many forgot to refer to heating, either when treating with acid or when testing with Benedict's reagent. Others omitted neutralisation or used completely inappropriate agents, such as alcohol. However, it was encouraging to find a significant number of good accounts which included reference to checking first for the presence of reducing sugar and then gave clear experimental instructions.

Question Two

(a) Nearly all candidates were aware that active transport requires energy and takes place against a concentration gradient, thus gaining two marks. A small number simply gave opposing aspects of the same point for the two parts.

(b) Many candidates gained one mark for correctly referring to carrier proteins, but only the better ones went on to describe their role, for example by explaining that energy is used to attach the ion or recognising that the proteins change their shape as ions are transported.

(c) (i) Most candidates correctly gave 930 as an answer, but weaker ones often had difficulty in the placement of the decimal point. Some simply subtracted one concentration from the other.

(ii) This was the most poorly answered question on the paper, with many candidates just repeating information about active transport from earlier sections without any reference to information in the table. Relatively few appeared to have studied the data and mentioned the different degrees of concentration or suggested that uptake is selective and performed by different carrier proteins.

Question Three

Answers to this question were in general disappointing, with many candidates displaying very limited knowledge of cell structure.

(a) Answers to this part seemed to be something of a lottery, with most candidates naming two organelles, but regardless of whether or not they would be visible with a light microscope, as required by the specification. Chloroplasts and nuclei were frequently given. Some referred to parts of organelles such as cristae and grana.

(b) Again, many candidates appeared to be unfamiliar with the specification requirement that they should know adaptations of palisade mesophyll cells. Large numbers described adaptations of leaves as a whole or of other tissues, usually the spongy mesophyll. Those who did answer the question most often mentioned the large number of chloroplasts as an adaptation for light absorption. Some correctly described the shape of the cells as being an adaptation, but often it was described as providing a large surface area for light uptake, ignoring the orientation of the cells. In part (ii), many referred to the cells having a thin membrane rather than a thin cell wall. References to surface area were more often creditworthy here.

Question Four

(a) (i) The majority of candidates correctly named maltose, but glucose was given by a significant minority.

(ii) The quality of answers varied significantly between centres. About half the candidates referred to a reduction in activation energy, but only the best showed awareness of what this means. Any explanation relating to less energy being needed in the formation of an enzyme-substrate complex, the breaking of bonds, change in shape of the enzyme molecule or the reaction occurring in smaller steps was credited. Many candidates, however, concentrated on body temperature being the optimum for enzyme activity, or gave irrelevant accounts of denaturation.

(b) There were many excellent accounts of enzyme action as answers to this part, and a considerable proportion of candidates gained full marks. Most understood that the reduction in activity was due to the change in shape of the active site as a result of denaturation, and many appreciated that the graph showed that it took time for the enzyme to denature. Weaker candidates sometimes assumed that the shape of the graph indicated a reduction in substrate concentration, or that denaturation was caused by the low temperature of 35°C compared with the optimum of 60°C.

Question Five

(a) (i) The majority of candidates could name the crista, although spelling was often distinctly wayward. A more precise name than 'inner membrane' was expected. A few suggested villi.

(ii) Most candidates recognised the role of mitochondria in providing energy or ATP, but many failed to qualify this with an acceptable suggestion as to why this extra energy might be needed, e.g. in relation to a higher rate of metabolism. Weaker candidates often referred to the large size of humans compared with plants.

(iii) The majority of candidates gained at least one mark for this part, usually for the function of ribosomes. There were many good answers from better candidates who thought about the roles in relation to mitochondria, and suggested either replication of the organelles or synthesis of enzymes. Weaker candidates tended to write about the use of genetic information for the cells.

(b) Most candidates appreciated the meaning of isotonic and gave an answer relating to water potential or osmotic effects. Unfortunately, many only gained one mark because they described the solution as preventing bursting of more of the cells rather than the mitochondria. A significant minority thought that the solution acted as a buffer against change in pH, or that it was a cold solution that stopped enzyme activity.

(c) The majority recognised that the result showed eukaryotic ribosomes to be denser or heavier, with a minority merely referring to size.

Question Six

(a) Most candidates obtained at least two marks in this part. The examiners were generous on this occasion and accepted any combination of H and OH groups from the ends of the molecules as indicating the formation of water during condensation. Most candidates could name the process. The third part was most often incorrect, with many candidates giving two as an answer, obviously not understanding the convention used in these formulae. A surprising number chose five as an answer.

(b) (i) Answers to this part were very disappointing, with most candidates apparently having no idea how to set about the calculation. The great majority ignored the information that the grass was 80% water.

(ii) Answers to this part were very variable. Good candidates often gave clear and accurate descriptions of the structure of cellulose molecules. Many, however, failed to appreciate the question was referring to molecules rather than to fibres and their

arrangement in cell walls. A considerable number of candidates confused cellulose with protein, and tried to describe tertiary structure.

(c) (i) A majority of candidates gained a mark, but quite a large proportion simply repeated information in the question without using information from the table.

(ii) Most recognised the advantage in terms of increasing the surface area, but often candidates did not go on to explain how this would increase the rate of enzyme activity or digestion. A disturbing number suggested that chewing would itself break down molecules.

(iii) The quality of answers varied considerably. Most candidates appreciated that an account of protein digestion was required, although a number left the section blank. Many, however, appeared to have a very limited knowledge of the process and often the only mark gained was that the proteins would be digested into amino acids. Good candidates, on the other hand, could describe the roles of endopeptidases and exopeptidases in some detail. Rather few mentioned the uptake of the amino acids into the blood in the intestine. Some weak candidates suggested that the microorganisms themselves would be absorbed into the blood through the wall of the rumen.

Question Seven

(a) This question generated marks covering the full range more or less evenly. Good candidates easily found 3 or 4 creditworthy points, but weaker ones often simply repeated themselves in respect of one or two aspects, usually surface area and thinness. Poor expression disqualified many answers, with references to the alveoli being thin or having thin membranes being particularly widespread. The link between ventilation or blood flow and the maintenance of a diffusion gradient was frequently inadequately explained. A surprisingly high proportion of candidates claimed incorrectly that the moist surface would increase the rate of diffusion.

(b) There were some very good answers to this part, although rather few gained all six marks. A majority clearly understood the basic principles involved, but answers often lacked detail. For example, many referred to the increased volume of the lungs or chest during inspiration, but failed to describe how the contraction of intercostal and diaphragm muscles achieves this. Very few seemed to be aware that the rise in pressure during expiration is largely due to elastic recoil of the lungs and contraction of internal intercostal muscles. Most suggested that relaxation of muscles increased the pressure. A significant number of weaker candidates was obviously completely confused about the relationship between pressure changes and volume. Many thought that breathing out started at point B on the graph.

(c) Most candidates could suggest at least one reason, usually the low concentration of oxygen in water, and an encouragingly large proportion gained two marks. Weak candidates often simply could not accept the premise and claimed that the animals would drown or that they do not have gills.

(d) The countercurrent principle was well known and most candidates at least understood the basic idea that water and blood flow in opposite directions. Many included the standard diagram showing concentrations of oxygen as numbers in each medium, but examination of these often revealed that the process of exchange was not understood. However, many candidates gained full marks by referring accurately to the maintenance of the concentration difference and the diffusion gradient.

Unit BYB2 Genes and Genetic Engineering

General Comments

The entry was small and therefore atypical. Conclusions are therefore to be regarded as tentative and may well be different when the whole of the ability range sits the examination in summer. It was very pleasing to note the large proportion of candidates who gained high marks in a test on a unit for which there is little groundwork in GCSE.

There was evidence that the majority of candidates were well prepared for the examination, but many failed to do justice to themselves by consistently failing to read the questions carefully or failing to take note of the mark allocations. Thus, many candidates merely gave descriptions rather than explanations, or gave one point where the mark allocation indicated that two or even three were required. There was a general tendency to confuse terms which have similar components such as chromosome and chromatid.

Question One

Few candidates obtained full marks on this question, which required nothing more than an understanding of what happens during mitosis. Candidates are required to be able to explain the stages in mitosis, but are not expected to know the stages of meiosis. Thus it was disturbing to find many candidates stating that chromosomes pair during prophase of mitosis.

There was a tendency to confuse words with similar sounds, thus most candidates used the terms chromosome and chromatid interchangeably, as they did with centromere and centriole, and spiralise and despiralise.

Few candidates described the events of metaphase fully, most referring to the events of metaphase as part of their description of anaphase. Only the better candidates gave DNA replication in part (b), most being content with despiralisation.

Question Two

The vast majority of candidates obtained full marks on parts (a) and (b) of this question. Part (c) was answered correctly only by the better candidates. Most candidates stated that that the drones would be identical because they were produced by mitosis, not realising that the eggs that develop into drones are produced by meiosis.

Question Three

(a) Most candidates answered part (i) correctly, but in part (ii) fewer knew that primers are added at step 2. Many candidates answered in terms of adding bases to the chain, rather than free nucleotides.

(b) A majority of candidates completed the diagram correctly, the rest failing to make clear which strands had been synthesised during cycle 2, i.e. drawing four pairs of strands identical to those at the end of cycle 1.

(c) The vast majority of candidates gave a forensic application, but significant numbers confused DNA replication with the production of proteins such as insulin.

Question Four

Most candidates had little difficulty with this question, but weaker candidates simply copied parts of the passage. These candidates often stated that humans would become resistant to kanomycin. Several candidates gave prepared answers which were not relevant to the question, usually including effects on the size of the gene pool. Candidates should be aware that marks are not given for statements such as 'We should not play God' and reference to 'more profits' must be qualified by a reason to gain credit.

Question Five

(a) The majority of candidates gained credit for maintaining favourable characteristics and the speed with which mature plants would be produced, but lost the third mark by not stating that the plants would be *genetically* identical.

(b) There was a frequent tendency to confuse cloning methods, particularly where removal and transplantation of nuclei were concerned. Many candidates used the terms cell, zygote and embryo interchangeably. Where candidates described embryo-splitting, there was generally a lack of detail e.g. at what stage the embryo is split and the need for further cell division before implantation.

Question Six

Most candidates understood the mechanism of gene mutation, but there was a general tendency amongst weaker candidates to confuse base sequence and amino acid sequence. Even better candidates were likely to state that 'a different amino acid will be produced'. Many candidates were awarded the marks for (b) in their account for (a). Most knew that gene mutation might result in an enzyme molecule with a different shape, but many did not complete the account by explaining what effect this would have.

Question Seven

Parts (a) and (b)(i) were answered correctly by the majority. Whilst most candidates could translate mRNA code into DNA code, many gave the sequence of the amino acids in the table rather than the sequence in the ribonuclease molecule.

Answers to (c)(i) were often vague, 'cytoplasm' being a common response. In (c)(ii) weaker candidates frequently described transcription rather than translation, therefore gaining no marks.
It was pleasing to note that the majority of candidates made a real attempt to explain structure in relation to function, rather than simply describing structure. Most accounts were largely in terms of the stability of the molecule, but there was frequent misunderstanding of the nature of bonds, hydrogen bonds being described as strong or weak by approximately equal numbers of candidates. There were few references to the fundamental role of DNA – the carrying of coded information as a sequence of bases.

Question Eight

(a) (i) This was the only question on the paper which was poorly answered. The vast majority of candidates did not appreciate the significance of attaching radioactive probes to the fragments and seemed to be unaware that the illustration of the end

result of the process had been produced by autoradiography. Consequently, most candidates did not attempt this part, or merely copied the information given.

(b) (i) Better candidates gave good accounts in terms of membrane channel proteins and osmosis, but there was some confusion as to whether chloride ions were prevented from leaving or entering the epithelial cells. Weaker candidates merely described the symptoms of cystic fibrosis.

(ii) Most candidates gained some credit for generalised genetic engineering techniques such as the use of endonucleases, plasmids or ligases, but few candidates went on to describe the insertion of plasmids containing the AAT gene into fertilised sheep eggs, or the implantation of sheep eggs into the uterus. There was a general belief that AAT is produced by bacteria in the same way as human insulin.

Mark Ranges and Award of Grades

Unit BYB1 Core Principles

Grade	A	B	C	D	E	U
UMS	72	63	54	45	36	0
Boundary Mark	41	35	30	24	19	0

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Written Paper	66	66	29.0	12.0

Unit BYB2 Genes and Genetic Engineering

Grade	A	B	C	D	E	U
UMS	72	63	54	45	36	0
Boundary Mark	44	38	32	26	20	0

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Written Paper	66	66	34.4	13.3

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade.

Mean Mark: the sum of all candidates' marks divided by the number of candidates. The mean (or average) mark measures a central tendency of a mark distribution (provided that the distribution is not skewed).

Standard Deviation: a measure of how widely candidates' marks are spread about the mean mark. When expressed as a percentage of the Maximum mark (scaled), small standard deviations indicate that the marks are "bunched" and large standard deviations indicate a wide spread of marks. In general, the marks of approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation about the mean mark.